Above Ceiling Inspections

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State of Connecticut
Department of Public Safety
Division of Fire, Emergency and Building Services

Above Ceiling Inspections

Objectives:

- Identify key building elements that require inspections above the ceiling.
- Review codes and other standards that should be reference during above ceiling inspection process.
- Discussion inspection related issues

Connecticut State Fire Safety Code

Sec.29-292-7e Inspections

(b) Each local fire marshal, the State Fire Marshal and their respective designees may conduct inspections as often as may be necessary during construction of new buildings, structures or additions, and during the course of renovations, alternations or modernizations for the purpose of satisfying themselves that all work is in accordance with approved plans and specifications.

IBC Portion of the State Building Code

- **Section 109.1 - Inspections**
  - Construction or work for which a permit is required shall be subject to inspection by the building official.
  - Construction or work shall remain accessible and exposed for inspection purposes until approved.

ABOVE CEILING INSPECTIONS
Overview

Above Ceiling Inspection: Shall be made at each floor level, all trades above ceiling line in place, ceiling grid in place, no tiles in place. Ceiling tiles shall not be installed until the above ceiling area has been inspected, systems tested, and approved**.**

Fire Marshal and Building Official inspect many of the same items during Above Ceiling Inspections but often from a different perspective.

ABOVE CEILING INSPECTIONS
What we need to look at.

Fire Marshal Perspective

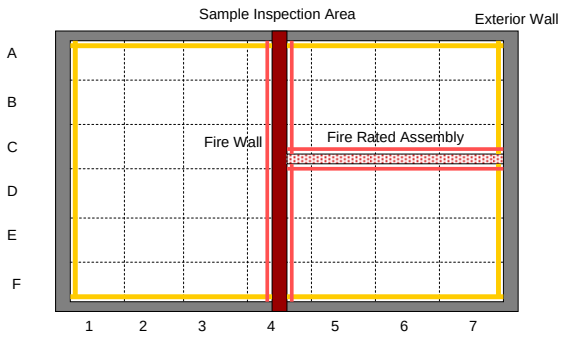
- **Fire Protection System Inspections**
- **Gas Inspection**
- **Mechanical Inspection**
- **Fire Resistance and Smoke Ratings**
- **Store Front Inspection**
- **Final Inspection**

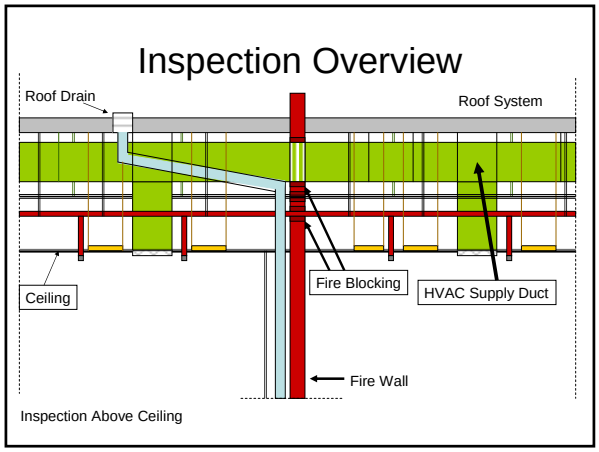
ABOVE CEILING INSPECTIONS
What we need to look at.

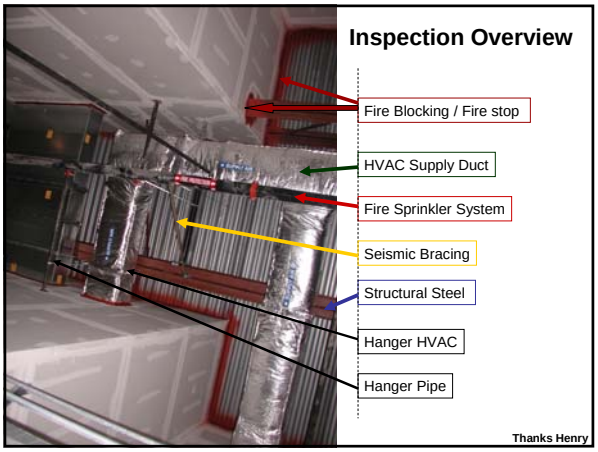
Building Official Perspective

- Structural
- Fire-Resistance Rated Construction
- Electrical
- Mechanical
- Plumbing

Inspection Overview







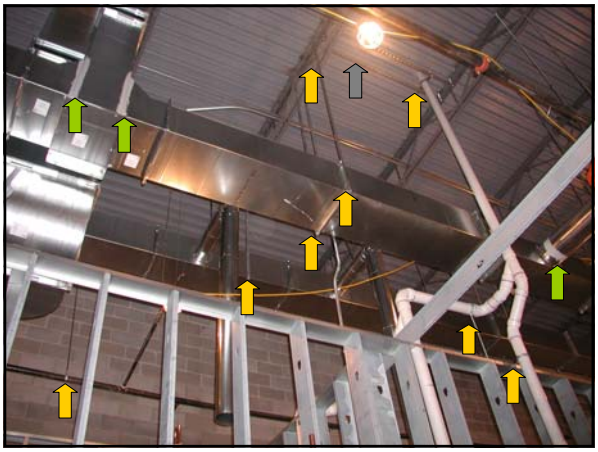
ABOVE CEILING INSPECTIONS
What we need to look at.

Building Official Perspective

- Structural – Building, structures and parts thereof shall be designed and constructed in accordance with strength design, loads and resistance factors design, allowable stress design, empirical design or conventional construction methods. (IBC)
- Fire-Resistance Rated Construction – Assemblies used for structural resistance and separation of adjacent spaces to safeguard against the spread of fire and smoke. (IBC)
- Electrical - Wiring within the cavity of a fire-rated floor-ceiling or roof-ceiling assembly shall be identified for this use, installed and supported in accordance with the NEC 2005.
- Mechanical System - Ducts and piping within floor-ceiling or roof-ceiling assembly shall be design, installed and supported in accordance with the IMC.
- Plumbing - Piping within floor-ceiling or roof-ceiling assembly shall be design, installed and supported in accordance with the IPC.

Structural

- Structural Systems
  - Design Loads
    - Dead Loads – IBC Section 1606 includes
      - weights of materials and construction
      - weights of fixed service equipment
- Structural Materials
  - Concrete
  - Masonry
  - Steel
  - Wood



Structural Steel Inspection

- Protection of Steel by approved methods IBC 2203.2
- Roof, wall members, panels, columns, bracing, bolts, washers and welds. Includes special inspections for steel elements of building IBC 1704.3
- Spray applied fire resistance materials.
- Third Party Reports

Masonry & Stone Inspection

- Anchor Ties
  - 1704.5 Special Inspections
  - 2104.1.3 Installation of wall ties
  - 2109.7 Anchorage
- Lintel and Bond Course
  - 1704.5 Special Inspections
  - 2104.1.5 Lintels
  - 2109.6 Bond

Masonry & Stone Inspection

- Horizontal and Vertical Reinforcement
  - 1704.5 Special Inspections
  - 2109.7.2.3 Joint Reinforcement
- Certification of Block, Brick and Accessories 1704.5
- Flashing, Damproofing, weeping, wicking, insulation and penetrations. (1704.5)
- Third party reports, prefab masonry units, assemblies, markings and ACI Standards
- Temporary Heat and Cold Weather Protection (2104.3.3)

Wood Construction Rough-in Inspection

- Fabricator Certification /Quality Control Procedures.(1704.6, 2303.0)
- Material Grading (2303.1.1)
- Connections (2304.9, 1704.6)
- Framing and Details (2304.3, 2304.4)
- Roof and Floor Diaphragms, Interior and Exterior Shear Walls. (2305.2 , 2305.3)

Fire-Resistance Rated Construction

Example:

Fire Walls - IBC Section 705

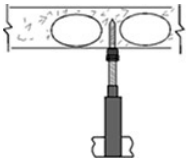
- Structural Stability
- Materials
- Fire-Resistance rating – not less than that required by Table 705.4
- Horizontal Continuity
- Vertical Continuity

Support of Above Ceiling Items

- **NEC Article 300 – Wiring Methods**
  - Raceways, cables assemblies, boxes, cabinets and fittings shall be securely fastened in place
- **IPC Section 308 - *Piping Support***
  - All Plumbing piping shall be supported in accordance to this section.
- **IMC Section 305 – *Piping Support***
  - All Mechanical system piping shall be supported in accordance with this section.
- **IMC Section 603 - Duct Construction and Installation** - ***Section 603.10 - Supports***
  - Ducts shall be supported with approved hangers at intervals not exceeding 10 feet.

Anchors

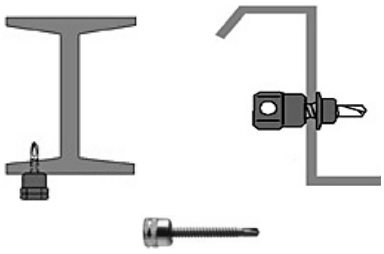
Concrete Anchor



Concrete Wedge Anchor

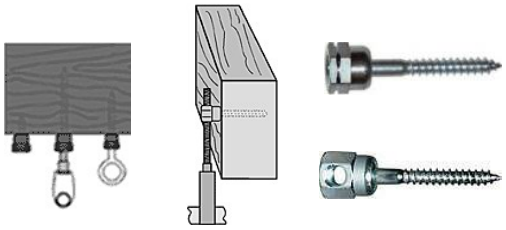
Anchors & Hangers

- **Steel Anchor**



Anchors & Hangers

- **Wood Anchors**



Electrical

NEC 2005 with CT Amendments

Securing and Supporting

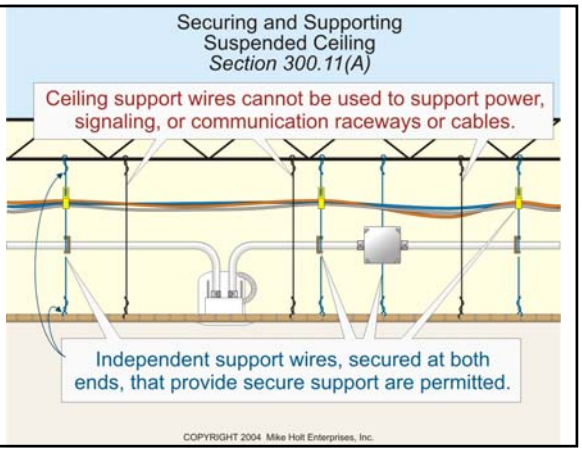
- Raceways and Cables
- Fire-Rated Assembly
- Outlet Boxes and Luminaires

NEC 2005
300.11 Securing and Supporting

- (A) Secured in Place. Raceways and cables must be securely fastened in place. Ceiling support wires or the ceiling grid cannot be used for support, however, independent support wires, secured at both ends are permitted.

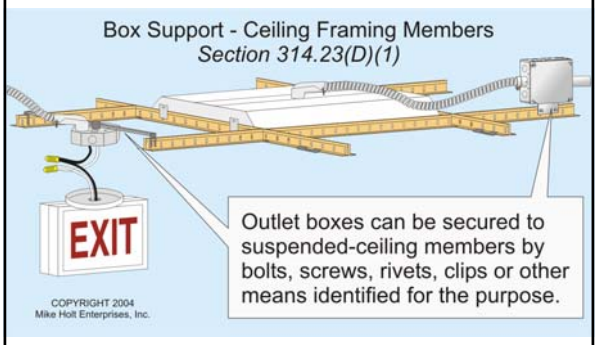
NEC 2005
300.11 Securing and Supporting

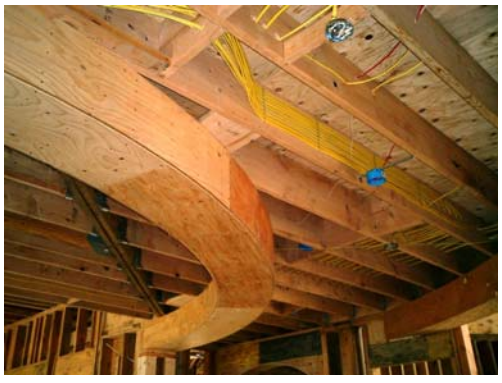
- (A) Secured in Place.
- (1) Fire-Rated Assembly. Electrical wiring within the cavity of a fire-rated floor-ceiling or roof-ceiling assembly can be supported by distinguishable independent support wires that are attached to the ceiling assembly. Fig 300-4

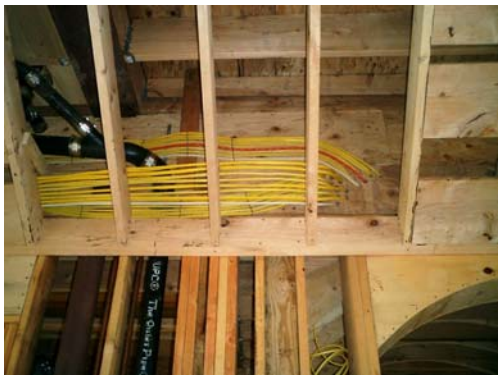


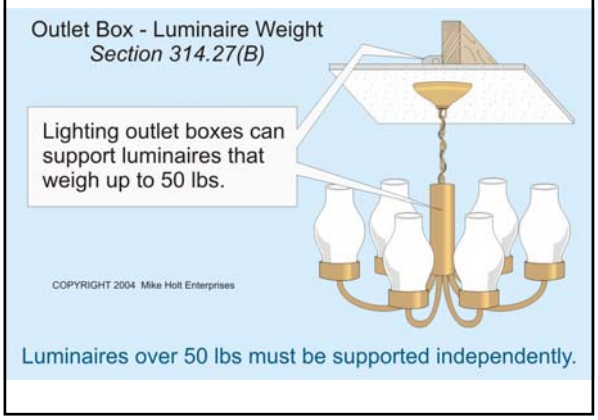
NEC 2005
300.11 Securing and Supporting

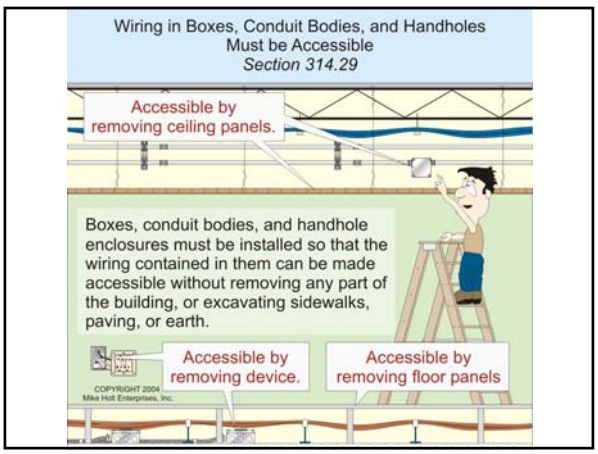
- Outlet boxes and luminaires can be secured to the ceiling grid if securely fastened to the ceiling-framing member. Fig 300-5








Outlet Box - Luminaire Weight
Section 314.27(B)
Lighting outlet boxes can support luminaires that weigh up to 50 lbs.
COPYRIGHT 2004 Mike Holt Enterprises
Luminaires over 50 lbs must be supported independently.


Wiring in Boxes, Conduit Bodies, and Handholes Must be Accessible
Section 314.29
Accessible by removing ceiling panels.
Boxes, conduit bodies, and handhole enclosures must be installed so that the wiring contained in them can be made accessible without removing any part of the building, or excavating sidewalks, paving, or earth.
Accessible by removing device.
Accessible by removing floor panels
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Mechanical

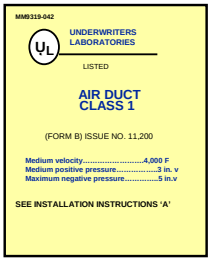
- Duct Construction
- Flexible Air Ducts
- Duct Installation
- Supports
- Ducts and Air Transfer Openings

Duct Construction

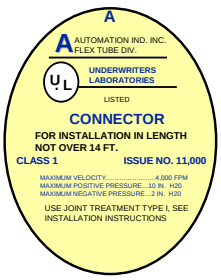
- ***IMC 603.2 Duct Sizing***
  - ***Use ACCA Manual D***
    - ***Or other approved method***
- ***IMC 603.4 Metallic Ducts***
  - ***To be constructed as per***
    - ***SMACNA***
- ***IMC 603.5 Nonmetallic ducts***
  - ***Construction to be with***
    - ***Class 0 or 1***
      - ***As per UL 181***

Flexible Air Ducts

IMC Section: 603.6 Flexible Air Ducts & Flexible Air Connectors



Flexible Air Duct Label Representation



Flexible Air Connector Label Representation

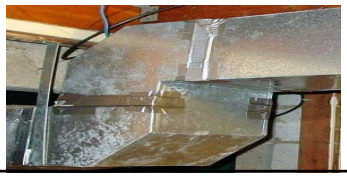
Labels

Duct Installation

- *603.7 Rigid Duct Penetrations*
  - *Floor, wall and ceiling penetrations*
    - *To be protected*
- *603.9 Joints, Seams & Connections*
  - *Construction to be as specified*
    - *In SMACNA or NAIMA*

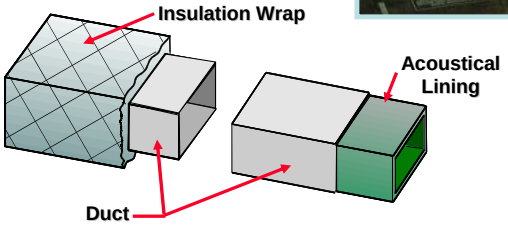
Supports

- *603.10 Supports*
  - *Intervals not to exceed 10 feet*
    - *By approved hangers*
  - *Flexible & factory made duct*
    - *Support per MFG installation instructions*



Duct Coverings

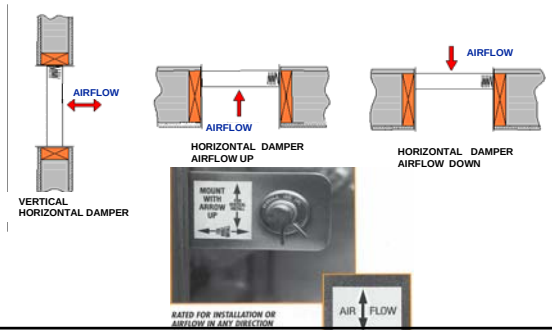
IMC Section 604.3



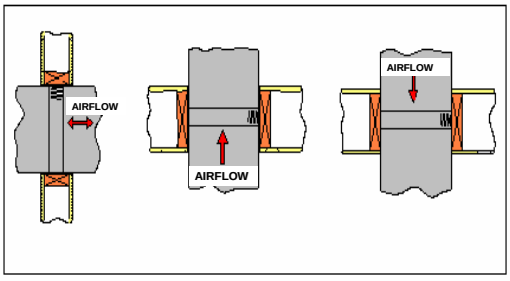
Ducts and Air Transfer Openings

- IMC Section 607
  - Governs the protection of Duct Penetrations and Air Transfer Openings in Fire-Resistance-Rated Assemblies
- IMC Section 607.3 Damper Testing and Ratings
  - Table 607.3.1 Fire Damper Rating
- IMC Section 607.4 Access and Identification
  - Dampers shall have an approved means of access, large enough to permit inspection and maintenance.

Smoke Detection Systems



Ducts & Air Transfer Openings

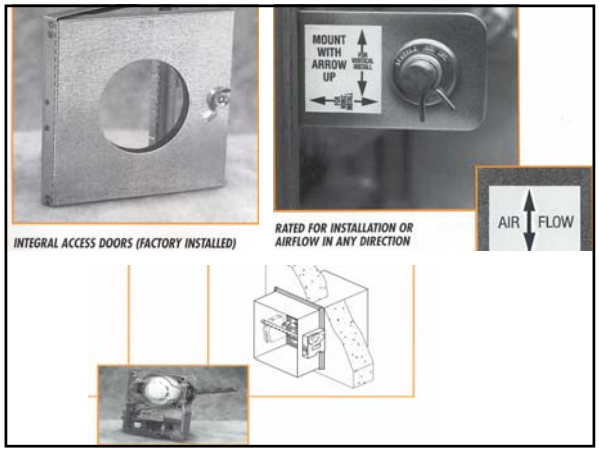


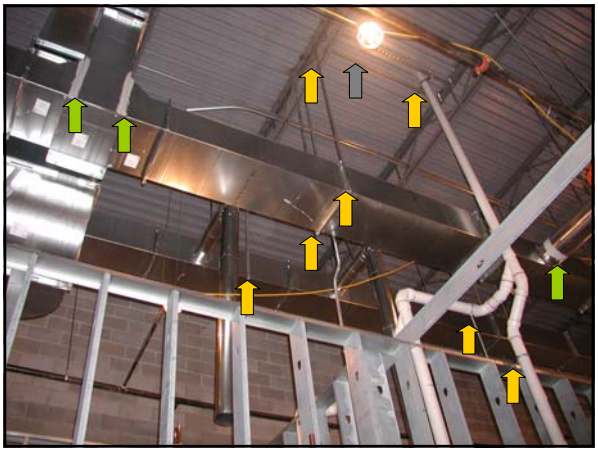
Fire and Smoke Dampers

Combination Fire Smoke Damper

Smoke Dampers

Fire Dampers





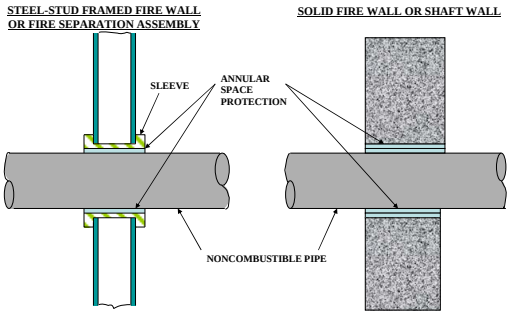
Plumbing

Above Ceiling Inspection Items include:

- Water Supply Systems
- Sanitary Drainage
- Vents

Annular Space Protection

Section 307.3 of IPC

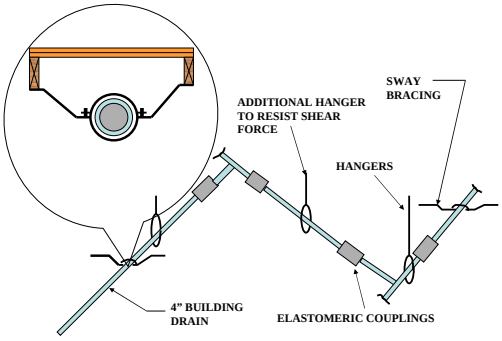


Hanger Spacing
Table 308.5 of IPC

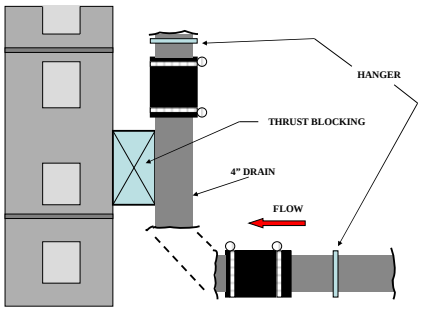
Piping Material	Max. Hor.	Max. Ver.
ABS pipe	4	10
Cast-iron pipe (a)	5	15
Copper or copper-alloy pipe	12	10
Copper or copper-alloy tubing 1 1/4-inch dia. Or smaller	6	10

Slide is representative of Table 308.5

Location Of Hangers & Sway Bracing



Anchorage Location



FIRE MARSHAL
ABOVE CEILING INSPECTIONS

PRESENTED BY
OFFICE OF STATE FIRE MARSHAL

ABOVE CEILING INSPECTIONS
What we need to look at.

- **Above Ceiling Inspection:** Shall be made at each floor level, all trades above ceiling line in place, ceiling grid in place, no tiles in place. Ceiling tiles shall not be installed until the above ceiling area has been inspected, systems tested, and approved.
- **Fire Protection System Inspections:** All Fire Protection Systems shall remain uncovered and convenient for examination until inspected and approved. Fire Protection System shall include but not be limited to Fire Sprinkler Systems, Fire Alarm Systems, Fire Extinguisher Systems.
- **Gas Inspection:** All piping installed shall not be covered until it has been examined, tested, and approved.
- **Mechanical Inspection:** Shall be made of all mechanical installation at each floor. Mechanical work shall be left uncovered until inspected and approved.
- **Store Front Inspection:** Shall be made after store fronts are installed and before store front attachments are concealed.
- **Final Inspection:** Shall be made, for each trade, after the work is completed and the structure is ready for use or occupancy.

"Workmanship Like Manner"

If the inspector sees this type of installation work at ceiling level, what might the inspector expect to find above the ceiling???

Fire Alarm Systems

What do we look for?

- Wiring has proper rating.
- Rated wire or in conduit.
- Support of the wiring.

2002 NFPA 72, *National Fire Alarm Code*

- NFPA 70, *National Electrical Code*

Prescribes the rules for point-to-point wiring in a fire protection signaling system.

Article 760 provides detailed requirements for wire types permitted in fire alarm systems.

There are two types of fire alarm system circuits:

Power-Limited Fire Alarm (PLFA) Circuits.

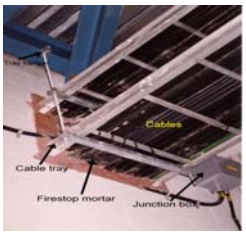
Nonpower-Limited Fire Alarm (NPLFA) Circuits.

Fire Alarm Wiring Supports

- ***Code requirements for supporting fire alarm system wiring to the building's structural components.***

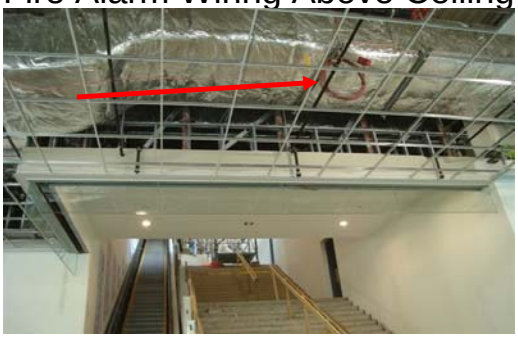
An inspector often only has to lift a tile from a drop-in grid ceiling to find fire alarm cable strung across the top.

Properly Supported Electrical and Fire Alarm Wiring



Cable Tray

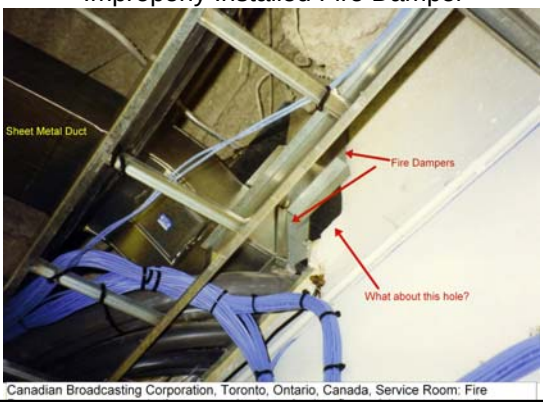
Fire Alarm Wiring Above Ceiling



You can see the red fire alarm wiring above the ceiling

Improper Support of Alarm & Electrical Wiring

Improperly Installed Fire Damper



Canadian Broadcasting Corporation, Toronto, Ontario, Canada, Service Room: Fire

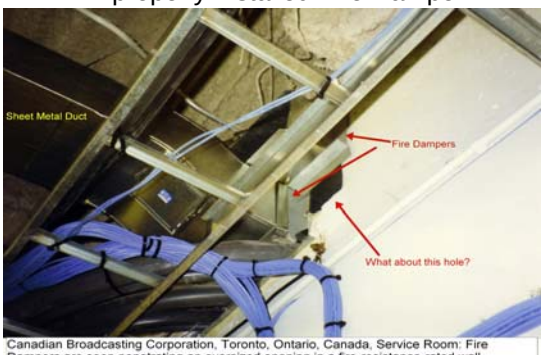
HVAC SYSTEMS

Fire Damper

Smoke Dampers

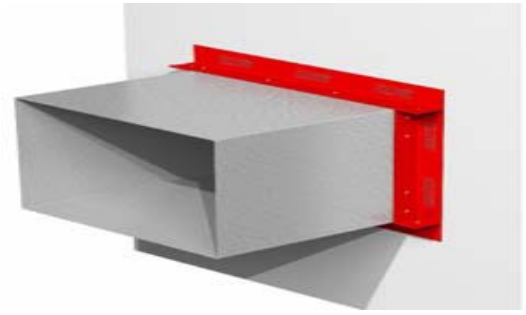
Fire/Smoke Dampers

Improperly Installed Fire Damper



Canadian Broadcasting Corporation, Toronto, Ontario, Canada, Service Room: Fire Dampers are seen penetrating an oversized opening in a fire-resistance-rated wall assembly. The opening is far too large and the angle lip surrounding each damper cannot cover the hole. This is an improper firestop on the outside of the dampers, resulting in the loss of the fire-resistance rating of the wall.

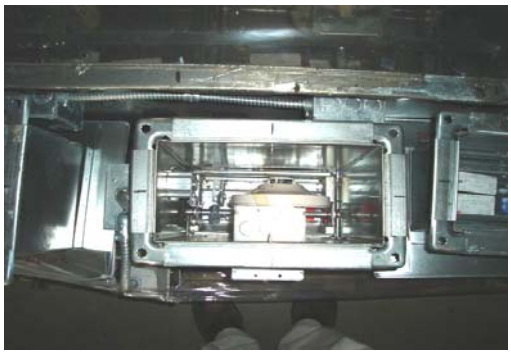
Fire/Smoke Damper Fire/Smoke Stop Angle



Proper Installation of Angle

Fire Damper

Combination Fire/Smoke Damper

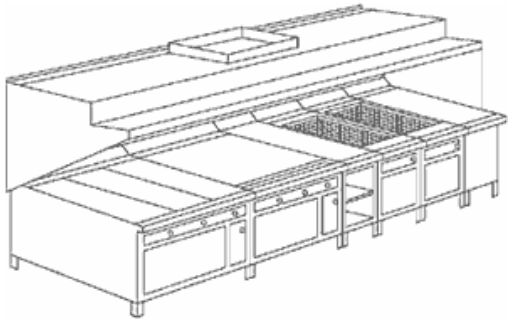


Initial Acceptance Test of Fire/Smoke Damper

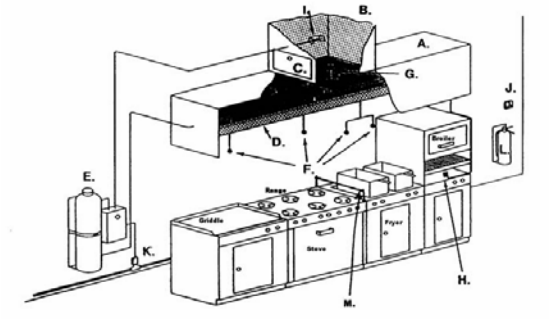
HVAC Ductwork & Sprinkler Piping

Supply Duct Area of Leakage

Commercial Cooking Exhaust Hoods

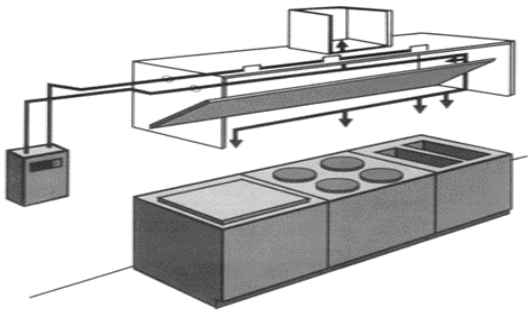


Commercial Cooking Exhaust Hoods & Exhaust Duct

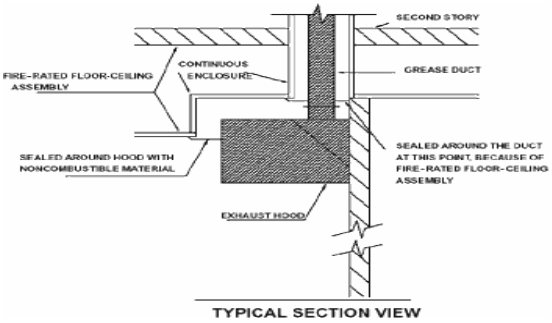


Commercial Kitchen Fire Suppression UL300 System Submittal

pre-engineered fixed extinguishing systems protecting cooking surfaces



Grease Duct Penetrating Second Floor



Grease Duct Requires a Listed Fire Rated Insulated Wrap

Non-compliant Grease Duct Flange Joint

Non-compliant Grease Duct Flange Joint Inside Look

Code Compliant Grease Duct Flange Joint Inside Look

Inside View of Code Compliant Grease Duct Installation

Non-compliant and Compliant Method of Bending Flange Joints

What is wrong with piece of welded duct work?

You can see the warping more clearly in this slide

Fire Protection Systems

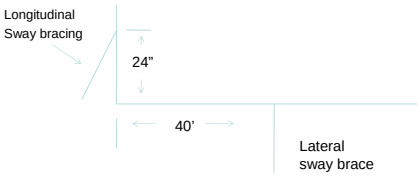
- Fire Sprinkler Systems
- NFPA 13 2002 edition adopted for new construction.

Fire Sprinkler Piping, Bracing & Hangers Systems
How it will show on sprinkler drawings

Chap 9

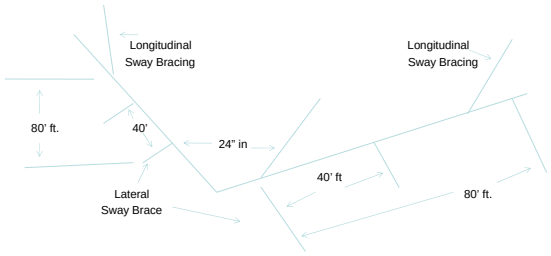
Lateral sway bracing spaced at a maximum interval of 40 ft (12.2 m) on center shall be provided on all feed and cross mains regardless of size and all branch lines and other piping with a diameter of 21/2 in. (63.5 mm) and larger. The last length of pipe at the end of a feed or cross main shall be provided with a lateral brace. **Lateral braces shall be allowed to act as longitudinal braces if they are within 24 in. (610 mm) of the centerline of the piping braced longitudinally** for lines that are 21/2 in. (63.5 mm) and greater in diameter. The distance between the last brace and the end of the pipe shall not exceed 20 ft (6.1 m). This requirement shall not preclude the use of a lateral brace serving as a longitudinal brace as described in this paragraph.

Remember the Rules for Bracing and Hangers

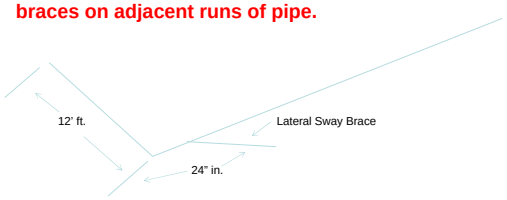


As long as we have a longitudinal sway brace within 24" of a turn it can serve as the lateral sway brace for the continuing main line or branch lines 21/2" or greater

The two sway braces located within 24" of the change in direction act as both lateral and longitudinal sway braces, so the additional lateral bracing would start 40' from that point and the longitudinal bracing would start at 80' from that point.

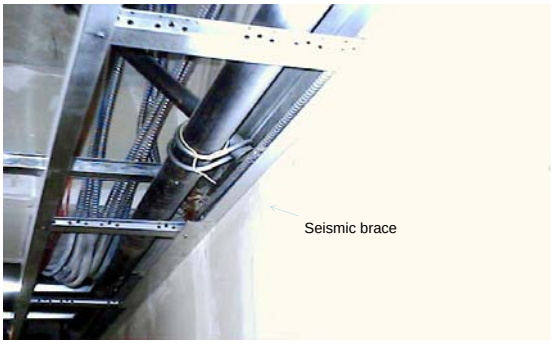


Exception: Pipe runs less than 12 ft (3.6 m) in length shall be permitted to be supported by the braces on adjacent runs of pipe.



The lateral sway brace serves as both lateral and longitudinal the 12' run of piping will not require any sway bracing. The sway brace shown in diagram could will also be a longitudinal sway brace, does not have to be a lateral sway brace and would serve the same purpose.

Sprinkler Seismic Bracing



Improper Sprinkler pipe Installation

Location of Sprinkler ???

Atrium Sprinkler Glass Protection

Sprinkler Piping Trapped

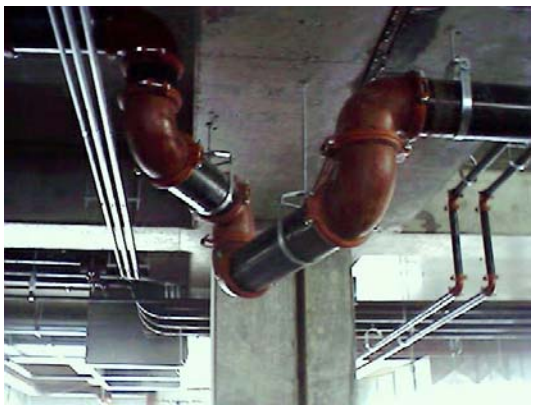
Sprinkler Protection Required Under Ductwork

ABOVECEILING INSPECTIONS

Fire Protection System Inspections

Sprinkler Piping

Sprinkler Piping in Unheated Area



Alarm, Electrical Mechanical, and Sprinkler Support Systems

Improper Hanger Installation

Gas Piping Installation or Repair

All new installations or repairs of gas piping shall be in compliance with:

NFPA 54 National Fuel Gas Code 1996 edition

Gas Shutoff Valve “Gas Cock”

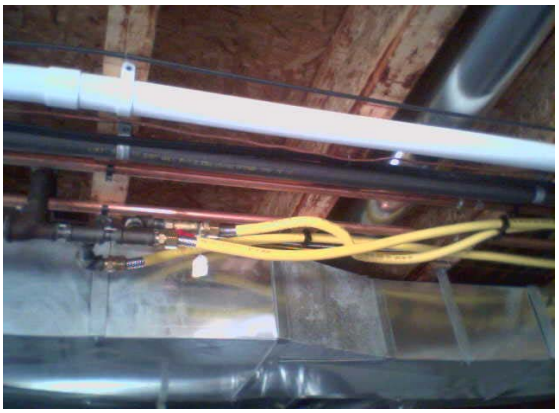
Gas Piping Being Worked On

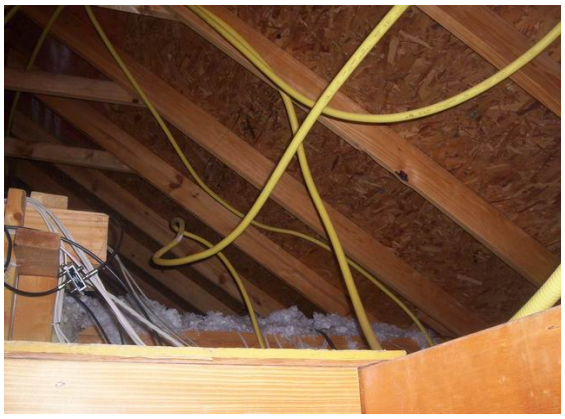
Gas Piping Being Worked On

Gas Piping Being Worked On

Protection of Gas Piping

The Following Slides Show Gas Trac Piping Improperly Installed:





ABOVE CEILING INSPECTIONS

FIRESTOP SYSTEMS for WALL &CEILING PENETRATIONS

Fire Safety: Who is Accountable?

- EXISTING BUILDINGS:
  The facility manager and maintenance department ultimately are responsible for building safety and ensuring safety systems, including fire stop systems, perform as intended. So how can managers make sure fire stop systems function properly?
- NEW CONSTRUCTION:
  The process is well defined for new-construction projects. The general contractor is liable until handing over the building to the facility management team. General contractors usually must assure subcontractors properly installed all fire stops according to the architect's plans. When employing an architect, managers need to make sure the architect is clear about the fire stop responsibilities of the contractor winning the bid.

Construction and Renovation Projects

THE INSPECTOR SHALL:

- In facilities where construction work has taken place in the above ceiling area, the inspector shall look at all fire and smoke decking and walls immediately.
- Making necessary repairs to fire-containment systems and documenting all violation and corrective work to help the contractors comply with building and fire codes.
- When facilities are in the middle of a construction, renovation or installation project the contractors shall be aware of the need to install and verify the proper listed fire an smoke penetration systems.
- The inspector shall make it a point to include the inspection of all fire and smoke penetration in any project they undertake.

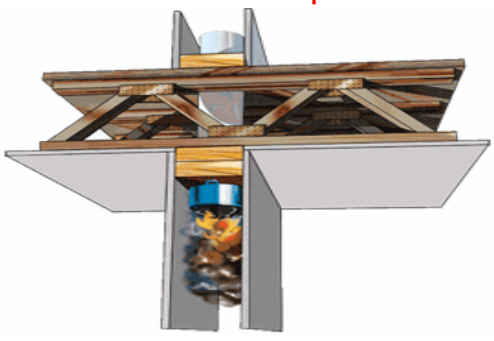
FIRE RESISTANCE & SMOKE RATINGS ABOVE CEILINGS
Regulations and Compliance

When an installed systems configuration is not in conformance with the appropriate certification listing as CODE requires.

- The fire-resistance rating may be less than expected.
- In those cases the impact, shall be assumed to be zero, which means that the fire protection plan for the building is compromised.
- For any deviations from this principle, one should contact the Authority Having Jurisdiction (AHJ) to gain acceptance of a suitable remedy.

Listed Smoke Only Penetration Protection

Needed Combination Fire/Smoke Damper ????



FIRE RESISTANCE & SMOKE RATINGS ABOVE CEILINGS
Regulations and Compliance

- The inspector SHALL be able to match each opening in fire-resistance or smoke rated wall or floor in a building with a certification listing.
- There are thousands of listings by various certification and testing laboratories which are accepted by the AHJ Authority Having Jurisdiction.
- The most common are:

Factory Mutual and Underwriter Laboratories

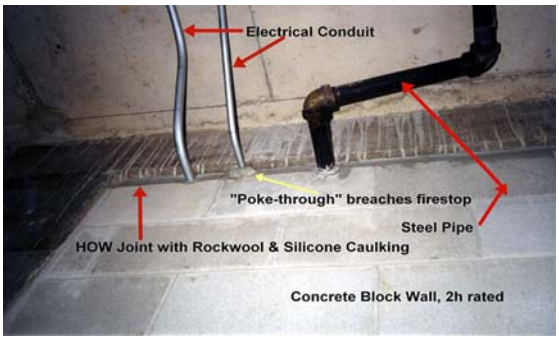
Each publish separate books containing just their own listings, including only those fire stop manufacturers who have contracted with them for testing and certification.

- Penetrations in Fire and Smoke resistant rated ceilings, floors, and walls shall be routinely inspected this will ensure they are maintained CODE compliant
- Even if not altered, some fire and smoke systems may fall apart over time.
- The only way to ensure the integrity of these systems and meet code requirement is to inspect above the ceiling areas.
- Ensure as built shop drawings exist, which show all fire and smoke resistant rated walls and floor assemblies and their specific ratings.

- A **firestop** is a passive fire protection system of various components used to seal openings and joints in fire-resistance rated wall and/or floor assemblies, based on fire testing and certification listings.
- Unprotected openings in fire separations void the fire-resistance ratings of the fire separations that contain them, allowing spread of fire past the limits of the fire safety plan of the entire building. Firestops are designed to restore the fire-resistance ratings of rated wall and/or floor assemblies by impeding the spread of fire through the opening by filling the openings with fire resistant materials.

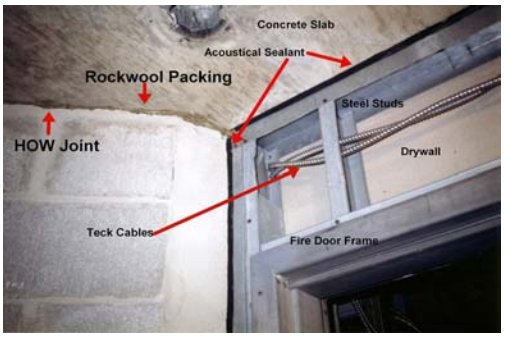
Doors and Ceilings Crucial to Firestop Systems

- Firestops in egress corridors and similar sections of facilities are especially critical. Properly installed passive firestops, teamed with the firestop capabilities of appropriately fire-rated doors, will confine fire and smoke locally and extend evacuation time.
- Fire-rated doors are designed to isolate an area and must stay closed to do so, but they cannot do the job if other firestops are not installed. So technicians should look at ceilings above doors to make sure wall and ceiling joints are in place.
- If something has compromised the integrity of the joints, they need to ensure the integrity is restored with the proper materials. If technicians are not sure if the proper firestopping material is in place, managers should schedule a visit by someone with thorough knowledge of fire codes and firestops.
- Areas above ceiling tiles often contain wires, pipes and conduits, so inspectors should look above the tiles to determine where these components penetrate walls and ceilings in an effort to make sure the proper firestops are installed. Failure to have firestops in these locations defeats the purpose of fire doors in hallways.



Head Of Wall - Building Joint:
The joint is penetrated both by electrical conduit (EMT = Electrical Metallic Tubing) and a steel pipe.

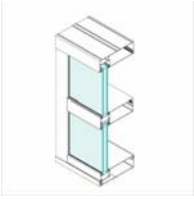
Head Of Wall Building Joint with incomplete firestop (top caulking is not yet installed.



Storefronts

- How are they anchored
- Interior
- Exterior

Storefront Design



Storefront Frame for Glass

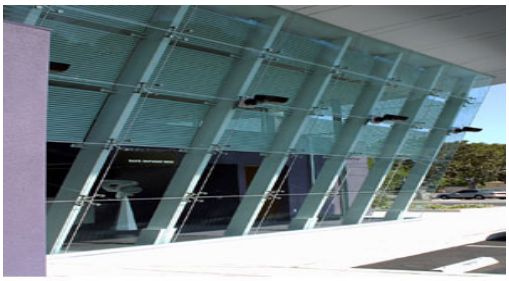
Starting to Install the Storefront

Improper Fastening Devices

Storefronts Can be of Any Size

High-rise Storefront

Storefront Showing Fastening Devices



World Saving & Loan - Alhambra, CA
Architect: Hodgetts and Fung - Culver City, CA

Door Storefront

Storefront Installation in Mall

Storefront Installation in Office Area

Summary

Above Ceiling Inspection are made at each floor level, all trades above ceiling line in place, ceiling grid in place, no tiles in place. Ceiling tiles shall not be installed until the above ceiling area has been inspected, systems tested, and approved**.**

Fire Marshal and Building Official inspect many of the same items during Above Ceiling Inspections but often from a different perspective.

Questions??

CT Department of Public Safety
Division of Fire, Emergency and Building Services

- Office of the State Building Inspector
  - (860) 685 - 8310
- Office of the State Fire Marshal
  - (860) 685 - 8350
- Office of Education and Data Management
  - (860) 685 – 8330

http://www.ct.gov/dps/

Thank-you !